

## CLAIMS

1. A template matching method of detecting the position of an image region similar to a template image region from on a reference image, characterized by comprising:

5           calculating the similarity of the image region to the template image region at rough position intervals;

          estimating the similarity at a position, where the similarity is not calculated, making use of the directional gradients of similarity obtained independently in a plurality of directions from the calculated values of  
10   similarity; and

          determining the position having a small calculated or estimated value of the similarity as the position of the similar image region.

2. A template matching method according to claim 1, characterized by estimating the similarity making use of the similarity estimated up to  
15   that time in addition to the calculated values of similarity.

3. A template matching method of narrowing down the position of a similar image region stepwise based on a multistep search method, characterized by detecting the position of the similar image region by the template matching method according to claim 1 or 2 at a search step before  
20   the final step thereof.

4. A template matching method according to claim 1 or 2, characterized by restricting the value range of the estimated similarity value such that the difference between the estimated similarity value and the similarity of a periphery used for the estimation or the gradient of the  
25   similarity does not exceed a threshold value.

5. A template matching method according to claim 4, characterized by determining the threshold value based on the magnitude of the similarity calculated from the template image region and an image region, which is obtained by moving the template image region in the same direction as or in  
30   the opposite direction to an estimation direction vector obtained by

subtracting the position of the nearby image region from the position where the similarity is estimated.

5 6. A template matching method according to any one of claims 1 to 5, characterized by estimating, when five reference image regions A, B, C, D, E are sequentially located on a straight line, the degree of similarity at the position C from an interpolation value extrapolated assuming gradient continuity from the similarity in the image regions A, B and from an interpolation value extrapolated assuming gradient continuity from the similarity in the image regions D, E in the estimation of the degree of  
10 similarity.

7. A template matching apparatus for detecting the position of an image region similar to a template image region from on a reference image, characterized by comprising:

15 means for calculating the similarity of the image region to the template image region at rough position intervals;

means for estimating the similarity at a position, where the similarity is not calculated, making use of the gradients of the similarity obtained independently in a plurality of directions from the calculated values of similarity; and

20 means for determining the position having a small calculated or estimated value of the similarity as the position of the similar image region.

25 8. A template matching apparatus according to claim 7, characterized by comprising means for estimating the degree of similarity making use of the similarity estimated up to that time in addition to the calculated values of similarity.

9. A template matching apparatus for narrowing down the position of a similar image region stepwise based on a multistep search method, characterized by detecting the position of the similar image region by the template matching apparatus according to claim 7 or 8 at a search step  
30 before the final step thereof.

10. A template matching apparatus according to claim 7 or 8, characterized by comprising means for restricting the value range of the

estimated similarity value such that the difference between the estimated similarity value and the similarity of a periphery used for the estimation or the gradient of the similarity does not exceed a threshold value.

11. A template matching method according to claim 10,  
5 characterized by comprising means for determining the threshold value based on the magnitude of the similarity calculated from the template image region and an image region, which is obtained by moving the template image region in the same direction as or in the opposite direction to an estimation direction vector obtained by subtracting the position of the  
10 nearby image region from the position where the degree of similarity is estimated.

12. A template matching method according to any one of claims 7 to 11, characterized by comprising means for estimating, when five reference image regions A, B, C, D, E are sequentially located on a straight line, the  
15 degree of similarity at the position C from an interpolation value extrapolated assuming gradient continuity from the similarity in the image regions A, B and from an interpolation value extrapolated assuming gradient continuity from the similarity in the image regions D, E in the estimation of the degree of similarity.

13. A computer readable recording medium that records a program for causing a computer to execute a template matching method of detecting the position of an image region similar to a template image region from on a reference image, characterized in that:

25 the method calculates the similarity of the image region to the template image region at rough position intervals;

the method estimates the similarity at a position, where the similarity is not calculated, making use of the gradients of similarity obtained independently in a plurality of directions from the calculated values of similarity; and

30 the method determines the position having a small calculated or estimated value of the similarity as the position of the similar image region.

14. A recording medium according to claim 13, characterized in that the degree of similarity is estimated making use of a similarity estimated up to that time in addition to the calculated values of similarity.

5 15. A computer readable recording medium that records a program for causing a computer to execute a template matching method of narrowing down the position of a similar image region stepwise based on a multistep search method, characterized in that the template matching method detects the position of the similar image region by being executed by a computer based on a program recorded on the recording medium according to claim 13  
10 or 14 at a search step before the final step thereof.

16. A recording medium according to claim 13 or 14, characterized in that the method restricts the value range of the estimated similarity value such that the difference between the estimated similarity value and the similarity of a periphery used for the estimation or the gradient of the  
15 similarity does not exceed a threshold value.

17. A recording medium according to claim 16, characterized in that the method determines the threshold value based on the magnitude of the similarity calculated from the template image region and an image region, which is obtained by moving the template image region in the same  
20 direction as or in the opposite direction to an estimation direction vector obtained by subtracting the position of the nearby image region from the position where the degree of similarity is estimated.

18. A recording medium according to any of claims 13 to 17, characterized in that the method estimates, when five reference image  
25 regions A, B, C, D, E are sequentially located on a straight line, the degree of similarity at the position C from an interpolation value extrapolated assuming gradient continuity from the similarity in the image regions A, B and from an interpolation value extrapolated assuming gradient continuity from the similarity in the image regions D, E in the estimation of the degree  
30 of similarity.